Claims

Claim **1**. An improved refractometer cell comprised of

A. a transparent material of refractive index n_g having a pair of plane exterior surfaces permitting a beam of light to be incident on a first surface;

B. two fluid-containing chambers separated by a transparent window therebetween, each chamber

1) forming a triangle,

2) at least one of whose sides in the path of the light beam passing therethrough is not parallel to a corresponding side of the other

3) the sides of said transparent window therebetween are parallel;

C. a mirror means adjacent to the rearmost exterior surface and parallel to said surface causing transmitted and refracted light beam to be reflected back through said improved cell and exiting at front exterior surface where its angular deviation relative to the direction of said incident light beam may be measured thereat.

Claim **2**. The improved cell of Claim **1** where said sides of said transparent window between said chambers are not parallel.

Claim **3**. The improved cell of Claim **1** where one of said triangular chambers is an isosceles right triangle.

Claim **4**. The improved cell of Claim **1** where said triangular chambers are similar.

Claim **5**. The improved cell of Claim **1** where said chambers are not of triangular form but are cavities that contain at least two plane, non-parallel surfaces.

Claim **6**. An improved refractometer cell comprised of

A. a transparent material of refractive index n_g having a pair of parallel exterior surfaces **9** and **14** permitting a beam of light **1** to be incident perpendicular thereto;

B. two fluid-containing chambers **4** and **6** separated by a transparent window therebetween, each chamber forming a triangle,

1) one **4** is an isosceles right triangle of 45° base angles,

2) the other **6** is a triangle with one 45° base angle and a second angle β slightly less than 45° yielding a third angle slightly greater than a right angle;

C. isosceles right triangle **4** chamber of 45° base angles having one side **10** thereof parallel to exterior surfaces **9** and **14**;

D. hypotenuse **11** of said isosceles right triangle parallel to longest surface **12** of said other triangular chamber **6**;

E. a mirror means adjacent to the rear surface **14** and parallel to said surface causing transmitted and refracted light beam to be reflected back through said improved cell and exiting at front surface **9** where its angular deviation may be measured thereat.

Claim **7**. The improved refractometer cell of Claim **6** where said mirror means is absent and deflection angle is measured at rear surface **14** thereof.

Claim **8**. A method to determine the angle β of the second chamber **6** of the improved refractometer cell **9** of Claim **1** when the cell refractive index n_g is known, comprising the steps of

A. preparing a solution whose refractive index n_1 is known;

B. filling both chambers of said refractometer cell with said fluid;

C. illuminating the cell with a fine beam of light whose vacuum wavelength λ_0 is known,

D. measuring the angle of deflection ψ of the transmitted beam

E. calculating β from the relation

$$\sin(\psi)=\frac{n_1\sqrt{2}}{2}\left\{\left[1-\left(\sin^2(\beta)(1-\left(\frac{n_g}{n_1}\right)^2 f^2)-2\sin(\beta)\cos(\beta)\left(\frac{n_g}{n_1}\right)f\left(1-\left(\frac{n_g}{n_1}\right)^2 f^2\right)^{\frac{1}{2}}+\cos^2(\beta)\left(\frac{n_g}{n_1}\right)^2 f^2\right)\right.\right.$$

$$\left.\left.-\left(\frac{n_2}{n_1}\right)\left[\sin(\beta)\left(1-\left(\frac{n_g}{n_1}\right)^2 f^2\right)^{\frac{1}{2}}-\cos(\beta)\left(\frac{n_g}{n_1}\right)f\right]\right\}$$

where

$$f=\sin(2\beta)g-\cos(2\beta)\left(1-g^2\right)^{\frac{1}{2}} \text{ and } g=\left(\frac{n_1}{n_g}\right)\{\cos(\beta)-\sin(\beta)\}\frac{\sqrt{2}}{2}.$$

Claim **9**. The method of Claim **8** for the case when $\beta\approx 45°$ and n_g is known and said angle β is determined from $\beta=\dfrac{\sin\psi}{2(n_g-n_1)}+\dfrac{\pi}{4}$ where said measured deflection angle is ψ.

Claim **10**. A method for measuring the refractive index of a liquid using the improved refractometer cell of Claim **1** comprising the steps of

A. filling both chambers of said cell with said liquid;

B. passing a fine beam of light therethrough;

C. measuring the deflection angle ψ of the emerging beam;

D. calculating said refractive index n_1 from the relation

$$\sin(\psi)=\frac{n_1\sqrt{2}}{2}\left\{\left[1-\left(\sin^2(\beta)(1-\left(\frac{n_g}{n_1}\right)^2 f^2)-2\sin(\beta)\cos(\beta)\left(\frac{n_g}{n_1}\right)f\left(1-\left(\frac{n_g}{n_1}\right)^2 f^2\right)^{\frac{1}{2}}+\cos^2(\beta)\left(\frac{n_g}{n_1}\right)^2 f^2\right)\right]^{\frac{1}{2}}\right.$$

$$\left.-\left(\frac{n_2}{n_1}\right)\left[\sin(\beta)\left(1-\left(\frac{n_g}{n_1}\right)^2 f^2\right)^{\frac{1}{2}}-\cos(\beta)\left(\frac{n_g}{n_1}\right)f\right]\right\}$$

where $f=\sin(2\beta)g-\cos(2\beta)\left(1-g^2\right)^{\frac{1}{2}}$ and $g=\left(\frac{n_1}{n_g}\right)\{\cos(\beta)-\sin(\beta)\}\frac{\sqrt{2}}{2}$.

Claim **11**. A method for measuring the refractive index difference Δn of two fluids of refractive indices n_2 and $n_2+\Delta n$, respectively, to first order in $\beta-\frac{\pi}{4}$ and second order in Δn using the improved refractometer cell of Claim **1** comprising the steps of

A. filling the first chamber **4** with said fluid of refractive index n_2 and the second chamber **6** with said second fluid of refractive index $n_2 + \Delta n$;

B. measuring the defection angle ψ of the emerging beam;

C. calculating Δn from the relation:

$$\sin(\psi)=2\Delta n\left\{1+\left(1-\frac{n_g}{n_2}\right)\left(\beta-\frac{\pi}{4}\right)\right\}+2\left(n_g-n_2\right)\left(\beta-\frac{\pi}{4}\right)+\Delta n^2\left\{\left(11\frac{n_g}{n_2^2}-\frac{1}{n_g}-\frac{10}{n_2}\right)\left(\beta-\frac{\pi}{4}\right)-\frac{1}{n_2}\right.$$

where n_g is the refractive index of said transparent cell.